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(54) EXHAUST GAS PURIFIER

(57)Abstract:
PURPOSE: To enhance an NOx purifying rate by effectively utilizing the whole of an NOx purifying catalyst.

CONSTITUTION: An NOx purifying catalyst 3 is provided to an exhaust gas passage 1. The NOx purifying catalyst 3 is formed by loading a transition metal on metallosilicate by ion exchange. An HC introducing passage 4 is connected to the intermediate part of the NOx purifying catalyst 3. For example, the bypass passage 2 branched from the exhaust passage 1 on the upstream side is connected to the intermediate part of the NOx purifying catalyst 3 and a temp. sensor 7 is connected to the NOx purifying catalyst 3. An HC control valve 9 controlling the flow rate of HC on the basis of the temp. detected by the temp. sensor 7 is provided to the HC introducing passage 4.

CLAIMS

[Claim(s)]
[Claim 1] An exhaust gas purifying facility characterized by connecting HC installation way which introduces HC into pars intermedia of the above-mentioned NOx purification catalyst in an exhaust gas purifying facility which prepares in metallosilicate an NOx purification catalyst which comes to carry out ion-exchange support of the transition metals, and purifies NOx in exhaust gas according to this NOx purification catalyst on an exhaust air way of exhaust gas.
[Claim 2] An exhaust gas purifying facility according to claim 1 to which a bypass way of exhaust gas which branched from an exhaust air way of the upstream from an NOx purification catalyst to pars intermedia of an NOx purification catalyst is connected.
[Claim 3] An NOx purification catalyst is an exhaust gas purifying facility according to claim 1 or 2 to which more than one are arranged in from the upstream of an exhaust air way to the downstream, and HC installation way is connected among these adjacent NOx purification catalysts.
[Claim 4] An exhaust gas purifying facility according to claim 1, 2, or 3 with which HC control bulb which controls a flow rate of HC in the middle of HC installation way based on temperature of an NOx purification catalyst which the above-mentioned temperature sensor detected while a temperature sensor is formed in an NOx purification catalyst is prepared.

PRIOR ART

[Description of the Prior Art] In recent years, development of a lean burn engine with low specific fuel consumption is furthered. The automobile in which this lean burn engine was carried establishes an engine combustion chamber in the bottom of a hyperoxia ambient atmosphere (Lean), and is driven. Since NOx which is poisonous gas is discharged so much from an engine in that case, this NOx must be purified and emission into atmospheric air must be prevented.
[0003] Conventionally, as an NOx purification catalyst which purifies NOx, although there are Cu ion-exchange zeolite, Cu support alumina, Cu support silica alumina, a noble-metals support alumina, etc., if engine exhaust gas temperature and the temperature into which the above-mentioned NOx purification catalyst decomposes NOx are taken into consideration, Cu ion-exchange zeolite which comes to support transition-metals ion, especially Cu ion to a zeolite is effective. Although this Cu ion-exchange zeolite understands NOx a returned part by the redox reaction of Cu ion in the activity location

on a catalyst, if HC does not exist in exhaust gas, it cannot decompose NOx in the lean burn operating range to which A/F (actual air-fuel ratio) exceeds 14.
[0004] Then, in the middle of the exhaust air way of exhaust gas, Cu ion-exchange zeolite is arranged as an NOx purification catalyst, the exhaust gas purifying facility into which made it make the gas which added HC from the upstream of this NOx purification catalyst flow is developed, and it is already well-known (refer to JP,3-124909,A).

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the graph which shows the relation between the exhaust gas temperature of the entry of an NOx purification catalyst, and the rate of NOx purification.
[Drawing 2] It is the graph which shows the relation between the temperature of an NOx purification catalyst, and the rate of NOx purification.
[Drawing 3] It is the block diagram of the exhaust gas purifying facility concerning the 1st example of this invention.
[Drawing 4] It is the graph which shows the NOx discharge and HC discharge to an air-fuel ratio.
[Drawing 5] In the example 1 of a comparison, it is the graph which shows each temporal response of the temperature of the NOx purification catalyst from the time of engine starting, and the rate of NOx purification.
[Drawing 6] It is the drawing 5 equivalent drawing in the example 2 of a comparison.
[Drawing 7] (a) The drawing 5 equivalent drawing in ******** 1, and (b) It is the graph which shows the by-pass rate of this emission control bulb.
[Drawing 8] It is the drawing 7 equivalent drawing in an example 2.
[Drawing 9] It is the drawing 7 equivalent drawing in an example 3.
[Drawing 10] It is the block diagram of the exhaust gas purifying facility concerning the 2nd example of this invention.
[Drawing 11] In the example 3 of a comparison, it is the graph which shows the temperature of the NOx purification catalyst in each catalyst portion.
[Drawing 12] It is the drawing 11 equivalent drawing in an example 4.
[Drawing 13] It is the perspective diagram of the exhaust gas purifying facility concerning the 3rd example of this invention.
[Drawing 14] It is a cross section for the said division.
[Drawing 15] It is the graph which shows the capacity which flows into each catalytic site when blowing gas into the exhaust gas purifying facility of drawing 13 .
[Drawing 16] In the 3rd example of this invention, it is the graph which shows the total amount of entrainments of the gaseous mixture containing HC, HC concentration, the temperature of an NOx purification catalyst, and the rate of NOx purification.
[Drawing 17] It is the perspective diagram showing a configuration with various openings.
[Drawing 18] It is the graph which shows the relation of the rate of NOx purification and HC distribution in the conventional exhaust gas purifying facility.
[Description of Notations]
1 Exhaust Air Way
2 Bypass Way

3 NOx Purification Catalyst
4, 14, 27 HC installation way
7, 21, 31 Temperature sensor
9, 20, 29 HC control bulb
A, B, C Exhaust gas purifying facility

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the exhaust gas purifying facility which purifies NOx in exhaust gas (nitrogen oxides).
[0002]
[Description of the Prior Art] In recent years, development of a lean burn engine with low specific fuel consumption is furthered. The automobile in which this lean burn engine was carried establishes an engine combustion chamber in the bottom of a hyperoxia ambient atmosphere (Lean), and is driven. Since NOx which is poisonous gas is discharged so much from an engine in that case, this NOx must be purified and emission into atmospheric air must be prevented.
[0003] Conventionally, as an NOx purification catalyst which purifies NOx, although there are Cu ion-exchange zeolite, Cu support alumina, Cu support silica alumina, a noble-metals support alumina, etc., if engine exhaust gas temperature and the temperature into which the above-mentioned NOx purification catalyst decomposes NOx are taken into consideration, Cu ion-exchange zeolite which comes to support transition-metals ion, especially Cu ion to a zeolite is effective. Although this Cu ion-exchange zeolite understands NOx a returned part by the redox reaction of Cu ion in the activity location on a catalyst, if HC does not exist in exhaust gas, it cannot decompose NOx in the lean burn operating range to which A/F (actual air-fuel ratio) exceeds 14.
[0004] Then, in the middle of the exhaust air way of exhaust gas, Cu ion-exchange zeolite is arranged as an NOx purification catalyst, the exhaust gas purifying facility into which made it make the gas which added HC from the upstream of this NOx purification catalyst flow is developed, and it is already well-known (refer to JP,3-124909,A).
[0005]
[Problem(s) to be Solved by the Invention] Drawing 18 shows distribution of HC which can be set at least to each part of an NOx purification catalyst when passing exhaust gas from the upstream to the above-mentioned conventional exhaust gas purifying facility, and the rate of NOx purification.
[0006] By the way, when exhaust gas [having come from an engine bay to the above-mentioned conventional exhaust gas purifying facility, without adding HC] (henceforth raw gas) is passed from the upstream, although HC burns on an NOx purification catalyst, as shown in drawing 18 , most of it is lost by the anterior part of the upstream of an NOx purification catalyst, and it hardly reaches to the posterior part of the downstream. Therefore, it is catalyst anterior part substantially to purify NOx.
[0007] Moreover, although the rate of NOx purification improves by adding HC and raising HC concentration in the above-mentioned conventional exhaust gas purifying facility as shown in drawing 18 , it all almost burns in the catalyst anterior part too, and

the problem that the high rate of NOx purification cannot be obtained is considering HC addition. On the contrary, when HC is added so much for the above-mentioned NOx purification catalyst, an NOx purification catalyst is heated by the heat of combustion of HC, and there is also a problem that activity falls or active species causes deterioration or structure destruction depending on the case.

[0008] Furthermore, the direction of oxidation reaction of HC by O2 in exhaust gas will advance, the decomposition reaction of NOx will not advance, and the NOx purification catalyst represented by Cu ion-exchange zeolite has the problem that activity falls, when exhaust gas is an elevated temperature.

[0009] Hereafter, the relation between HC concentration in exhaust gas and an NOx purification catalyst is explained.

[0010] Drawing 1 shows the relation between the exhaust gas temperature of the catalyst entry of the NOx purification catalyst based on a certain experiment, and the rate of NOx purification, and drawing 2 shows the relation of the temperature of an NOx purification catalyst and the rate of NOx purification in the same experiment. It was what conducted the above-mentioned experiment by the neighboring exhaust gas presentation using the 1.3l. engine at the time of an idle, and for O2, 8% and NOx are [2000 ppm and SV (space velocity)] 25000 h-1, and HC concentration experimented in 2500 ppm of the presentation by the case (it expresses as a dashed line) of .C and the case (it expresses as a continuous line) of 6000ppm.C which added HC at the time of raw gas.

[0011] As shown in drawing 1 , in the state of raw gas, the rate of NOx purification shows [the exhaust gas temperature of a catalyst entry] a peak price near about 430 degree C, and the rate of NOx purification falls suddenly from the neighborhood where the exhaust gas temperature of a catalyst entry exceeded 600 degrees C. Moreover, as shown in drawing 2 , whenever [catalyst temperature / of an NOx purification catalyst / the rate's of NOx purification] improves near 500 degree C, and the rate of NOx purification falls from the neighborhood where whenever [above-mentioned catalyst temperature] exceeded 650 degrees C.

[0012] Although the light on temperature which begins to purify NOx shifts an NOx purification catalyst to a low temperature side so that HC concentration will become high, if the rate of NOx purification is seen on the basis of the exhaust gas temperature of a catalyst entry, on the other hand, the temperature from which the fall of activity begins becomes low. Although the light on temperature of NOx is shifted to a low temperature side compared with the case where there are few amounts of O2 when there are many amounts of O2 in exhaust gas, the activity at the time of an elevated temperature hardly changes. Next, when the rate of NOx purification is seen on the basis of whenever [catalyst temperature], as for most shifts, a light on temperature and the fall initiation temperature of activity are not seen from which side of change of HC concentration, and change of O2 amount, either.

[0013] Moreover, it is thought of for combustion of HC to advance that the rate of NOx purification changes with the exhaust gas temperatures of a catalyst entry when the temperature of exhaust gas becomes an elevated temperature. And if all the NOx purification catalysts known now consider not demonstrating the purification engine performance of NOx collectively only under coexistence of HC, it will be thought that change of the rate of NOx purification by exhaust gas temperature is a phenomenon common to all the above-mentioned NOx purification catalysts.

[0014] Therefore, it is thought that an NOx purification catalyst has the following properties. That is, although the reaction in low temperature advances and the rate of NOx purification is raised so that HC concentration is high, whenever [catalyst temperature] becomes an elevated temperature with HC heat of combustion beyond necessity, and the reduction reaction on a catalyst stops being able to progress easily. Moreover, although combustion of HC becomes easy to progress and the rate of NOx purification at the time of low temperature is raised so that there is much O2 concentration, at an elevated temperature, oxidation of HC progresses and the rate of NOx purification falls. In these many points, by the method of raising HC concentration in exhaust gas like before, the NOx purification catalyst represented by Cu ion-exchange zeolite cannot improve the rate of NOx purification rather than is effective. In order to raise the rate of NOx purification, it is important how whenever [catalyst temperature] is controlled paying attention to the phenomenon of the rise of whenever [by combustion of HC / catalyst temperature].

[0015] This design was made in view of such many points, and the place made into the purpose can purify NOx effectively, and tends to offer the exhaust gas purifying facility which can raise the rate of NOx purification.

[0016]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention according to claim 1 prepares in metallosilicate an NOx purification catalyst which comes to carry out ion-exchange support of the transition metals on an exhaust air way of exhaust gas, and is taken as a configuration which connects HC installation way which introduces HC into pars intermedia of the above-mentioned NOx purification catalyst in an exhaust gas purifying facility which purifies NOx in exhaust gas with this NOx purification catalyst.

[0017] Invention according to claim 2 is taken as a configuration which connects a bypass way of exhaust gas which branched from an exhaust air way of the upstream from an NOx purification catalyst to pars intermedia of an NOx purification catalyst in invention of the claim 1 above-mentioned publication.

[0018] In invention above-mentioned claim 1 or given in two, invention according to claim 3 arranges two or more NOx purification catalysts from the upstream of an exhaust air way to the downstream, and is taken as a configuration which connects HC installation way among these adjacent NOx purification catalysts.

[0019] In invention above-mentioned claims 1 and 2 or given in three, invention according to claim 4 is taken as a configuration which prepares HC control bulb which controls a flow rate of HC in the middle of HC installation way based on temperature of an NOx purification catalyst which the above-mentioned temperature sensor detected while it forms a temperature sensor in an NOx purification catalyst.

[0020]

[Function] By the above-mentioned configuration, in invention according to claim 1 By introducing HC from NOx purification catalyst pars intermedia from HC installation way to the portion of the downstream Since reduction decomposition of NOx purified by neither elevated-temperature-izing of exhaust gas nor the temperature rise of the NOx purification catalyst itself in the upstream portion of an NOx purification catalyst is carried out in the downstream portion of an NOx purification catalyst and NOx is purified effectively, the rate of NOx purification can be raised.

[0021] Especially, in invention according to claim 2, since a part of exhaust gas is introduced with HC to the downstream portion of an NOx purification catalyst, a comparable NOx reduction reaction is promoted in the upstream portion and downstream portion of an NOx purification catalyst, and NOx is purified effectively.
[0022] Moreover, in invention according to claim 3, since two or more NOx purification catalysts arranged in the exhaust air way promote an NOx reduction reaction by work of HC introduced into each, they can purify NOx very effectively.
[0023] Furthermore, since a temperature sensor detects the temperature of an NOx purification catalyst and HC control bulb controls the amount of supply of HC by invention according to claim 4 based on it, an NOx purification catalyst does not become an elevated temperature beyond necessity, and deterioration and structure destruction of the activity of a catalyst can be prevented. Moreover, since the flow rate of HC is controlled based on detection of a temperature sensor so that HC control bulb always maintains the temperature of an NOx purification catalyst at an activity temperature region, NOx can always be purified efficiently, using HC effectively.
[0024]
[Example] Hereafter, the example of this invention is explained based on a drawing.
[0025] Drawing 3 shows the exhaust-gas purifying facility concerning the example of this invention, and the bypass way of the exhaust gas with which 1 branched on the exhaust-air way of exhaust gas, and 2 branched in the middle of this exhaust-air way 1, and 3 are the NOx purification catalysts prepared in the downstream of the above-mentioned exhaust-air way 1, and this NOx purification catalyst 3 is a catalyst which comes to carry out the ion exchange of the transition metals to the zeolite which is a kind of metallosilicate, and understands NOx in exhaust gas a returned part. 4 is HC installation way connected in the middle of the above-mentioned bypass way 2, and this HC installation way 4 is sharing the downstream until HC flows with carrier air and results near the pars intermedia of the above-mentioned NOx purification catalyst 3 with the above-mentioned bypass way 2.
[0026] The above-mentioned NOx purification catalyst 3 is divided into the catalyst anterior part 5 of the upstream, and the catalyst posterior part 6 of the downstream in the pars intermedia at which the above-mentioned bypass way 2 has arrived. The temperature sensor 7 is formed in the above-mentioned catalyst anterior part 5 and the catalyst posterior part 6, respectively, and each temperature sensor 7 detects the temperature of the above-mentioned catalyst anterior part 5 and the catalyst posterior part 6, respectively.
[0027] The emission control bulb 8 which can adjust the amount of switches at the time of switching the exhaust gas which flows the above-mentioned exhaust air way 1 to the above-mentioned bypass way 2 (henceforth a by-pass rate) to arbitration is formed in the turning point of the above-mentioned exhaust air way 1 and the above-mentioned bypass way 2. Moreover, HC control bulb 9 which controls the flow rate of HC which flows in the catalyst posterior part 6 direction of the above-mentioned NOx purification catalyst 3 is formed in the down-stream edge which meets with the above-mentioned bypass way 2 of the above-mentioned HC installation way 4. It connects with the above-mentioned temperature sensors 7 and 7, and the above-mentioned emission control bulb 8 and HC control bulb 9 control the flow rate of exhaust gas or HC according to the temperature of

the catalyst anterior part 5 which these temperature sensors 7 and 7 detected, and the catalyst posterior part 6.

[0028] The A/F sensor 10 which measures an air-fuel ratio to the upstream of the entry of the above-mentioned NOx purification catalyst 3, and the exhaust gas temperature sensor 11 which measures the temperature of exhaust gas are formed in the above-mentioned exhaust air way 1 and the bypass way 2. Moreover, flue-gas-analysis equipment (not shown) is connected to the exhaust air way 1, and the flow rate of exhaust gas and a presentation are measured with this flue-gas-analysis equipment.

[0029] Next, the contents of control at the time of controlling the amount of installation of HC to the NOx purification catalyst 3 and the by-pass rate of the exhaust gas to the above-mentioned bypass way 2 according to a service condition are explained.

[0030] In order to make low NOx reduction initiation temperature of the NOx purification catalyst 3, the by-pass rate of the exhaust gas to the bypass way 2 is made to increase at the time of a cold start. You begin a by-pass rate from 0 at first, and it makes it increase after that according to the amount of discharge HC and the amount of discharge NO(s) which were calculated from the temperature of the catalyst anterior part 5 of the NOx purification catalyst 3, and engine combustion conditions in that case.

[0031] At the time of a hot start, since the temperature of the catalyst anterior part 5 of the NOx purification catalyst 3 and the catalyst posterior part 6 is to some extent high, the emission control bulb 8 is controlled and a by-pass rate is adjusted so that the amount of HC corresponding to whenever each catalyst temperature] may be sent in to the catalyst anterior part 5 and the catalyst posterior part 6.

[0032] At the time of operation of regular **, if a HC/NO ratio is a suitable value, the amount of exhaust gas supplied to the direction of the catalyst portion by the side of an elevated temperature will be stopped so that it may not result in the temperature to which each temperature of the catalyst anterior part 5 of the NOx purification catalyst 3 and the catalyst posterior part 6 rises too much, and invites an activity fall. In order to control on conditions with most amounts of NOx purification by the NOx purification catalyst 3 whole depending on the case, while cooling the catalyst anterior part 5 only for carrier air with a sink and this air from HC control bulb 9, exhaust gas may be first sent into the catalyst posterior part 6 side, and it may carry out making the catalyst anterior part 5 bypass exhaust gas after that etc., and the catalyst anterior part 5 and the catalyst posterior part 6 may be used effectively. After detecting the temperature rise of the catalyst anterior part 5 at this time, since the reaction which was overdue to the suitable conditions of a catalyst will be carried out, by having performed feedback control of sending exhaust gas into the catalyst posterior part 6, it is desirable to control the temperature rise of the catalyst anterior part 5 as an estimate beforehand.

[0033] At the time of acceleration-and-deceleration operation, in case a HC/NO ratio is imbalanced and NOx is discharged, sufficient amount of HC to return NOx into exhaust gas may not be. At this time, HC is added to the degree from which an aperture and the NOx purification catalyst 3 do not invite HC control bulb for an activity fall at the NOx purification catalyst 3.

[0034] Next, the operation effect of this example is explained. Since HC is introduced from HC installation way 4 at the catalyst posterior part 6 of the NOx purification catalyst 3, reduction decomposition of NOx purified by neither elevated-temperature-izing of exhaust gas nor the temperature rise of the NOx purification catalyst itself by the

catalyst anterior part 5 of the NOx purification catalyst 3 is carried out in the catalyst posterior part 6 and NOx is purified effectively, the rate of NOx purification can be raised.
[0035] Moreover, since a part of exhaust gas which contains HC to the catalyst posterior part 6 of the NOx purification catalyst 3 is introduced, a comparable NOx reduction reaction is promoted in the catalyst anterior part 5 and the catalyst posterior part 6 of the NOx purification catalyst 3, and NOx can be purified effectively.
[0036] Furthermore, since temperature sensors 7 and 7 detect the temperature of the catalyst anterior part 5 and the catalyst posterior part 6 and HC control bulb 9 controls the amount of supply of HC based on it, the NOx purification catalyst 3 does not become an elevated temperature beyond necessity, and deterioration and structure destruction of the activity of a catalyst can be prevented. Moreover, since the flow rate of HC is controlled based on detection of temperature sensors 7 and 7 so that HC control bulb 9 always maintains the temperature of the catalyst anterior part 5 and the catalyst posterior part 6 at an activity temperature region, NOx can always be purified efficiently, using HC effectively.
[0037] In addition, although the temperature sensor 7 was formed in the both sides of the catalyst anterior part 5 and the catalyst posterior part 6, you may constitute from the 1st example of the above so that it may prepare only in the catalyst anterior part 5.
[0038] Moreover, although HC installation way 4 was connected in the middle of the bypass way 2, you may constitute from the 1st example of the above so that it may connect with the exhaust air way 1 of the upstream from the emission control bulb 8.
[0039] Furthermore, although flue-gas-analysis equipment is formed in the exhaust air way 1 and the flow rate of exhaust gas and a presentation are measured with this flue-gas-analysis equipment in the 1st example of the above, the flow rate of exhaust gas and a presentation are map-ized with an engine rotational frequency, a load, water temperature, etc., and you may make it presume them from this map.
[0040] Hereafter, the examples of the above-mentioned exhaust gas purifying facility A are enumerated with the example of a comparison, and the operation is described. In addition, the NOx purification catalyst 3 used for an example and the example of a comparison was manufactured as follows.
First, 100g [/l.] Cu ion-exchange zeolite was supported to the support 400 cel made from a KODI light / inch2, and 1.3l., and the NOx purification catalyst 3 was manufactured to it. This NOx purification catalyst 3 was divided into merits [order], and in the container in which it was prepared all over the exhaust air way 1, the divided catalyst anterior p art 5 and the catalyst posterior part 6 were arranged so that it might be located in the upstream and the downstream. an NOx discharge and HC discharge -- engine-speed 1500rpm the time -- the output torque -- 1.5kgf(s) and m -- setting -- drawing 4 -- being shown -- a value -- it was . [as opposed to / the thing of 1.6l. and four bulbs is used for an engine, and / A/F] This engine was made for an engine speed to work [2000rpm and a boost] by carrying out to regularity at -400mmHg, respectively. In this case, after exhaust gas temperature carries out fixed time amount progress from the time of engine starting, it shall rise gradually and shall go.
[0041] When example of comparison 1 A/F was set to 22, the 4000 ppm of the amounts of HC were made into the constant rate of -C and exhaust gas was passed from the upstream of the catalyst anterior part 5, as shown in drawing 5 , whenever [catalyst

temperature] went up [rise / of exhaust gas temperature] with the passage of time again. When the NOx reduction reaction started, whenever [catalyst temperature] went up further by combustion of HC, and the rate of NOx purification fell from the neighborhood exceeding 600 degrees C. The NOx purification catalyst 3 stopped then, showing NOx purification activity. In the time of a hot start, the rise of whenever [catalyst temperature] occurred early and also generated the activity fall of the NOx purification catalyst 3 early.

[0042] Although the same action as the example 1 of a comparison was shown as shown in drawing 6 when HC was added from the upstream of the catalyst anterior part 5 in addition to the exhaust gas conditions of the example 1 of example of comparison 2 comparison, as for the rise of whenever [catalyst temperature], only the part of the rate of NOx purification with many amounts of HC improved early. However, the climbing speed of whenever [catalyst temperature] was quicker than the example 1 of a comparison, and the activity fall of the NOx purification catalyst 3 also started early.

[0043] When example 1 A/F passed the exhaust gas of a value lower than theoretical air fuel ratio from the upstream of the catalyst anterior part 5, as shown in drawing 7 (a), the catalyst anterior part 5 reached activity temperature early, and the rate's of NOx purification improved like the example 1 of a comparison. Although the catalyst posterior part 6 is late for the catalyst anterior part 5 and temperature rises at this time, when the catalyst posterior part 6 reaches activity temperature, the catalyst anterior part 5 will already have consumed most HC. Then, before the catalyst anterior part 5 resulted in the optimal activity temperature, measuring the temperature of the catalyst anterior part 5 with a temperature sensor 7, as shown in drawing 7 (b), the by-pass rate of the emission control bulb 8 was increased gradually, and exhaust gas was passed to the bypass way 2, it went, and exhaust gas was sent to the catalyst posterior part 6. Thereby, in addition to having prevented the rapid temperature rise of the catalyst anterior part 5, the NOx reduction reaction in the catalyst posterior part 6 advanced efficiently. In the catalyst posterior part 6, since there was a possibility of resulting in whenever catalyst temperature / which causes an activity fall] with the heat of the exhaust gas which flows from the catalyst anterior part 5, and the self-heat of reaction at the time of NOx reduction, the temperature sensor 7 adjusted the by-pass rate of the emission control bulb 8 based on the value which measured the temperature of the catalyst posterior part 6. Thus, measuring the temperature of the catalyst anterior part 5 and the catalyst posterior part 6, by always passing efficiently for NOx reduction of the exhaust gas containing HC, the NOx purification poisoning produced with the passage of time could be prevented, and the high rate of NOx purification was able to be held. In addition, a judgment of the by-pass rate of the emission control bulb 8 was made based on the exhaust gas flow rate measured with A/F value, an engine operation condition, and flue-gas-analysis equipment (not shown) by predicting rise and fall of the temperature of the catalyst anterior part 5 and the catalyst posterior part 6.

[0044] The Lean exhaust gas with which example 2A / F value exceeds 22 was passed. At the time of a cold start, the same operation effect was acquired by performing the same actuation as an example 1. the time of a hot start -- drawing 8 (a) and (b) The emission control bulb 8 was opened based on the temperature of the catalyst anterior part 5 and the catalyst posterior part 6, the by-pass rate was made about 50%, and exhaust gas

was passed to the catalyst anterior part 5 and the catalyst posterior part 6 so that it might be shown. The by-pass rate of the emission control bulb 8 was adjusted measuring the temperature of the catalyst anterior part 5 and the catalyst posterior part 6 also after that. This acquired the same operation effect as an example 1.

[0045] The exhaust gas of the same conditions as example 3 example 2 was passed. In order to make a HC/NO ratio into the suitable value for NOx reduction, taking into consideration whenever [catalyst temperature], and O2 amount in exhaust gas in that case, As shown in drawing 9 (b), when the gas which opens HC control bulb 9 and contains HC was added to the bypass way 2 and a sink and HC were added to the catalyst posterior part 6, as shown in drawing 9 (a), the catalyst anterior part 5 and the catalyst posterior part 6 reached activity temperature early, and its rate of NOx purification of an initial stage improved. Then, while increasing the by-pass rate of exhaust gas gradually and sending exhaust gas to the catalyst posterior part 6, HC addition sent into the catalyst posterior part 6 was reduced. Thereby, in addition to having prevented the rapid temperature rise of the catalyst anterior part 5 and the catalyst posterior part 6, the NOx reduction reaction of the NOx purification catalyst 3 whole advanced efficiently. In addition, by sending only carrier air from HC control bulb 9 depending on the case, as the temperature rise of the catalyst posterior part 6 was suppressed and the optimal activity temperature for NOx purification was held, the rate of NOx purification was also able to be raised further.

[0046] Drawing 10 showed the exhaust gas purifying facility B concerning the 2nd example of this invention, and this exhaust gas purifying facility B equips the exhaust air way 1 of exhaust gas with the NOx purification catalyst 3 which comes to carry out the ion exchange of the transition metals to a zeolite like the 1st example of the above. The fork road 15 where this NOx purification catalyst 3 branched from upstream HC installation way 14 from the upstream of the exhaust air way 1 to the downstream among the NOx purification catalysts which five-piece 3a-3e arrangement of is done every predetermined gap, and adjoin each other is connected.

[0047] The above-mentioned HC installation way 14 is equipped with HC supply way 16 which supplies HC, such as gas oil and a gasoline, the air supply way 17 which supplies carrier air, the premixing machine 18, and the compressor 19. Within the above-mentioned premixing machine 18, HC and carrier air are mixed, gaseous mixture is made, and this gaseous mixture is sent to each above-mentioned fork road 15 with the pressure of the above-mentioned compressor 19.

[0048] HC control bulb 20 which controls the flow rate of HC is formed in each above-mentioned fork road 15, and the temperature sensor 21 is connected to each above-mentioned NOx purification catalysts 3a-3e, respectively. And based on the temperature of each NOx purification catalysts 3a-3e detected by each of this temperature sensor 21, the amount of HC supplied among the NOx purification catalysts 3a-3d of the adjoining upstream is determined.

[0049] Like the 1st example of the above, by introducing HC from HC installation way 14 to the NOx purification catalysts 3b-3e of the downstream, NOx is purified effectively and can raise the rate of NOx purification of the whole catalyst also in the exhaust gas purifying facility B of this example.

Moreover, since a temperature sensor 21 detects whenever [catalyst temperature] and the amount of supply of HC is controlled by HC control bulb 20 based on it, while being

able to prevent deterioration and structure destruction of the activity of the NOx purification catalysts 3a-3e, the NOx purification catalysts 3a-3e can always be held in an activity temperature region, and NOx can always be purified efficiently.
[0050] Furthermore, according to the exhaust gas purifying facility B of this example, since two or more NOx purification catalysts 3a-3e arranged in the exhaust air way 1 promote an NOx reduction reaction by work of HC introduced into each, they can purify NOx very effectively.
[0051] Hereafter, the example of the above-mentioned exhaust gas purifying facility B is illustrated with the example of a comparison, and the operation is described. In addition, the NOx purification catalyst used for the following example and the example of a comparison used the same object as the above-mentioned examples 1-3.
[0052] although the rate of NOx purification of the NOx purification catalysts 3a and 3b of the upstream improved compared with HC addition before, without controlling the amount of HC to each NOx purification catalysts 3a-3e when 1500 ppm added -C every equally as a continuous line showed to example of comparison 3 drawing 11 The amount of HC combustion increased, the temperature of exhaust gas rose as it went to the downstream, and the phenomenon in which the temperature of the NOx purification catalysts 3c-3e of the downstream will exceed an activity temperature region in multiplication occurred. Therefore, the rate of NOx purification of the NOx purification catalysts 3c-3e of the downstream fell compared with the NOx purification catalysts 3a and 3b of the upstream, and the rate of NOx purification as the whole did not improve greatly. In addition, in drawing 11 , a catalyst location shows the location of the NOx purification catalysts 3a-3e arranged from the upstream to the downstream.
[0053] As shown in example 4 drawing 12 , when HC of optimum dose was added for each NOx purification catalysts 3a-3e, it could prevent that each NOx purification catalysts 3a-3e caused an activity fall across an activity temperature region, the NOx purification catalyst whole [3]
demonstrated the NOx purification engine performance efficiently, and the whole rate of NOx purification improved. In addition, the location of the NOx purification catalysts 3a-3e is shown like [the catalyst location in drawing 12] drawing 11 .
[0054] Drawing 13 and drawing 14 showed the exhaust gas purifying facility C concerning the 3rd example of this invention, and this exhaust gas purifying facility C equips the exhaust air way 1 of exhaust gas with five NOx purification catalysts 3a-3e which come to carry out the ion exchange of the transition metals to a zeolite like the 2nd example of the above. These NOx purification catalysts 3a-3e are stored in the inside container 25 among the internal and external containers 25 and 26 of double structure, and from the upstream of the exhaust air way 1, as they extend the gap of NOx purification catalysts gradually to the downstream, they are arranged to it.
[0055] It is formed in HC installation way 27 through which HC passes between the above-mentioned inside container 25 and the outside container 26, and this HC installation way 27 is connected with HC supply way 28 which supplies the gaseous mixture which contains HC by the upstream. this HC supply way 28 -- the above -- HC control bulb 29 which controls the flow rate of gaseous mixture is formed.
[0056] Two or more openings 30 and 30 and -- which lead to the above-mentioned HC installation way 27 are formed on the circumference surrounding between adjacent NOx purification catalysts, and these openings 30 and 30 and -- are formed in the above-

mentioned inside container 25 so that the path may be enlarged, as it goes to the downstream.

[0057] The temperature sensor 31 is connected to each above-mentioned NOx purification catalysts 3a-3e. These temperature sensors 31 and 31 and -- detect the temperature of each NOx purification catalysts 3a-3e, the above-mentioned HC control bulb 29 is operated based on the detected temperature, and the amount of HC supplied to the above-mentioned HC installation way 27 is controlled.

[0058] Drawing 15 shows the inflow which reaches at least each part of the NOx purification catalyst 3 over the total amount of entrainments at the time of blowing gas into the above-mentioned HC installation way 27 to the above-mentioned exhaust gas purifying facility C. To NOx purification catalyst 3a of the upstream, gas flows uniformly and goes, so that the amount of entrainments of gas is increased, as shown in this drawing. Then, when detecting an elevated temperature to which a temperature sensor 31 reaches activity fall temperature to NOx purification catalyst 3a of the upstream, While increasing the amount of entrainments of the gaseous mixture which operates HC control bulb 29 and flows into HC installation way 27 and reducing the temperature of NOx purification catalyst 3a of the upstream By supplying HC to NOx purification catalyst 3a of the upstream, NOx can be purified efficiently and the rate of NOx purification can be raised.

[0059] Of course also in the exhaust gas purifying facility C of this example, the same effect as the 2nd example of the above is acquired.

[0060] Drawing 16 shows the result of having purified NOx using the above-mentioned exhaust gas purifying facility C. As shown in this drawing, while being able to supply HC stably into the NOx purification catalyst 3 by controlling the amount of entrainments of the gaseous mixture which contains HC to the NOx purification catalyst 3, too much rise of whenever [catalyst temperature] could be suppressed, and the high rate of NOx purification was able to be held stably.

[0061] In addition, in the 3rd example of the above, although the gas introduced to HC installation way 27 was gaseous mixture which consists of HC and carrier air, it may be structure which the exhaust air way of the upstream is branched and introduces a part of exhaust gas to HC installation way 27.

[0062] Moreover, although the configuration of a opening 30 enlarged the path in the 3rd example of the above as it went to the downstream For example, drawing 17 (a) and (b) You may constitute so that openings 31 and 32 may be heaped up highly, as it goes to the downstream so that it may be shown, and it is drawing 17 (c). So that it may be shown The board 34 of a standup is formed in the down-stream edge of a opening 33, and the height of this board 34 may be made high, and you may constitute so that gas may be made easy to incorporate, as it goes to the downstream.

[0063] Furthermore, although the NOx purification catalyst 3 was divided and arranged in plurality in the above 1st - the 3rd example, the whole NOx purification catalyst may consist of one piece.

[0064] Moreover, in the above 1st - the 3rd example, as a reducing agent of NOx, although HC was used, H2, NH3, C, a urea, etc. may be used in addition to HC.

[0065] Moreover, although the catalyst which comes to carry out ion-exchange support of the transition metals was used for the zeolite as an NOx purification catalyst in the above

1st - the 3rd example, you may constitute from metallosilicate, such as other alumina silicate, and Si-Tb-O, Si-Mn-O, Si-Nd-O, instead of a zeolite.
[0066]
[Effect of the Invention] As mentioned above, since reduction decomposition of NOx is carried out [according to the exhaust gas purifying facility according to claim 1] also in the downstream portion of an NOx purification catalyst by introducing HC from NOx purification catalyst pars intermedia from HC installation way to the portion of the downstream in addition to the upstream portion of an NOx purification catalyst, NOx is purified effectively and can raise the rate of NOx purification.
[0067] According to the exhaust gas purifying facility according to claim 2, since a part of exhaust gas is introduced with HC to the downstream portion of an NOx purification catalyst, a comparable NOx reduction reaction is promoted in the upstream portion and downstream portion of an NOx purification catalyst, and NOx is purified effectively.
[0068] According to the exhaust gas purifying facility according to claim 3, since two or more NOx purification catalysts arranged in the exhaust air way promote an NOx reduction reaction by work of HC introduced into each, they can purify NOx very effectively.
[0069] Since according to the exhaust gas purifying facility according to claim 4 a temperature sensor detects the temperature of an NOx purification catalyst and HC control bulb controls the amount of supply of HC based on it, an NOx purification catalyst does not become an elevated temperature beyond necessity, and deterioration and structure destruction of the activity of a catalyst can be prevented. Moreover, since the flow rate of HC is controlled so that HC control bulb always maintains the temperature of an NOx purification catalyst at an activity temperature region, NOx can be purified at the always high rate of purification.